Indian Journal of Biochemistry & Biophysics
Vol. 57, August 2020, pp. 439-443

Quantitative analysis of international collaboration on COVID-19: Indian perspective

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Received 05 July 2020; *revised 13 July 2020*

This paper analyses COVID-19 research papers in international collaboration by Indian researchers indexed in the web of Science core collection database through co-authorship. Indian researchers have published 290 publications out of which 128 (44.14%) were in international collaboration. The papers in international collaboration have received 63.19% of total citations as compared to 36.80% received by non-international collaborative papers. The impact of publication in international collaboration is 2.56 while non-international collaborative papers have 1.15 citations per publication. Dr D Y Patil Vidyapeeth, Pune is the most productive organization whereas Hainan Medical University China is the most preferred collaboration organizations. Among the countries, Peoples Republic of China is the most preferred country for collaboration followed by USA, Thailand and England.

Keywords: COVID-19, International Collaboration, Research evaluation, Scientometric

Collaboration in research promotes working together to achieve a common goals to create new information and knowledge. Collaboration in research is mutually beneficial for collaborators. In Biomedical industry-academia collaboration at the national and international levels is most prevalent as the result obtained through experiments is of clinical importance and the production of new drugs cannot be imagined without the help of industries. The recent decade witnessed a rapid increase in international collaboration[1] (Witze 2016) also journal impact factor and international collaborations are in linear correlation[2] (Low *et al*. 2014). Publications in international collaboration are considered as a proxy for quality. It also helps the larger groups as compared to publications in domestic or no collaboration. It has also been opined that papers in international collaboration tend to receive more citation[3]. International collaboration in various disciplines and countries has been studied extensively. The Severity of the COVID-19 pandemic has posed the worst health emergencies, thus it is a crucial need to collaborate internationally both in public and private sectors to explore the possibility of therapeutic and vaccines. Pathak & Kumari (2019)[4] analysed India's international collaboration in pharmaceutical sciences during 2008-2014. Earlier Gupta and Dhawan[5], and Raina *et al.*[6] used Web of science to investigate collaboration patterns of Indian science. Pathak[7] (2020) analysed COVID-19 publications from India using the dimensions database.

Methodology

Data for this study was retrieved from Web of Science-core collection database using advance search feature on 20th June 2020. Keyword "COVID -19" OR "CoV-19" OR "2019-nCoV" OR "SARS CoV-2") in the topic field was used to untries section, India was refined. In this way, 290 results were retrieved. These results were downloaded in the MS-Excel file and were used for further analysis. All the results were checked manually to remove any factual error. There were many variants for the name of authors and organizations which were normalized to standard names. VosViewer software was used to determine the co-authorship and keyword network. The publications which have India and any other countries in the address were selected exclusively. The collaboration was determined by the address given in the database.

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Results and Discussion

Impact of international collaboration

Analysis of this paper reveals that out of total of 290 publications on COVID-19 128 are in international collaboration which is 44.13% of total publications, 124 papers are in domestic collaboration and 38 publications are without collaboration. Publications in international collaboration have also better citation rate than domestic or non-collaborating paper as the publications in international collaboration have 328 citations which are 63.19% of the total citation with average citations of 2.56 in comparison to 191 citations which is 36.80% with average citations 1.17 to non- international collaborated papers (Table 1).

Source titles

The 290 publications on COVID-19 have been published in a total 158 journals whereas 128 publications in international collaboration have been published in 96 journals. Analysis of source titles preferred by Indian authors reveals that the publications in international collaboration have been published in relatively higher impact factors as compared to overall publications. Among top 5 journals in which internationally co-authored papers have been published, two journals are published from India (Tables 2 & 3). Among the most prolific journals Journal of Biomolecular Structure & Dynamics has published the most number of papers *i.e.* 13. This journal had an impact factor 3.31 (JCR 2018) but in the 2020 release of JCR there is no mention of this journal. This journal is followed by Indian Journal of Surgery (0.561) with 12 publications, Journal of Medical Virology (2.021) with 11 publications, Dermatologic Therapy (2.327) with 10 publications, Indian Journal of Orthopaedics (0.92) and Indian Journal of Paediatrics (1.508) with 9 publications each.

Among the journals with the most number of internationally co-authored paper Dermatologic Therapy (2.327) with 8 publications is the leading the list followed by Journal of Medical Virology (2.021) and publications, Indian Journal of Psychiatry (1.121) with 4 publications each, Asian Pacific Journal of Tropical Medicine (1.94) and European Review for Medical and Pharmacological Sciences (3.024) 3 publications each.

Countries in collaboration

Country-wise analysis of data reveals that there are 74 countries which are in collaboration with Indian researchers in COVID-19 research. Amongst the top five countries (Table 4) Peoples Republic of China is a leading collaborating partner with 47 publications which is 36.72% of total papers in international collaboration and 16.20% of total publications on COVID-19 form India. The Peoples Republic of China is followed by the USA with 36 publication and 143 citations with average citations 3.97 per publication, Thailand with 33 publication cited 91 times with average citation 2.76 per publication, England with 23 publications cited 88 times and average citation 3.83 per item and Italy with 18 publications cited 73 times having 4.06 average citation

Table 1 — Impact of International & Non international collaborative Publication

	Paper	Citation	Impact
IC	128	328	2.56
NIC	162	191	1.18

Table 2 — Journals (IF_{2019}) with >5 overall publications

Sl. No	Journals	Records
1	Journal of Biomolecular Structure & Dynamics (NA)	13
2	Indian Journal of Surgery (0.561)	12
3	Journal of Medical Virology (2.021)	11
4	Dermatologic Therapy (2.327)	10
5	Indian Journal of Orthopaedics (0.92)	9
6	Indian Journal of Pediatrics (1.508)	9

Table 3 — Journals with publication in international collaboration

Journal	IF_{2019}	Papers
Dermatologic Therapy	2.327	8
Journal of Medical Virology	2.021	4
Indian Journal of Psychiatry	1.121	4
Asian Pacific Journal of Tropical Medicine	1.94	3
European Review for Medical and Pharmacological Sciences	3.024	3

Table 4 — Countries with ≥10 publication in Collaboration

Sl. No	Countries	Records	Citation
1	Peoples R China	47	201
2	USA	36	143
3	Thailand	33	91
4	England	23	88
5	Italy	18	73
6	South Korea	13	82
7	Brazil	12t	31
8	Switzerland	12	14
9	Germany	11	34
10	Canada	10	6
11	Iran	10	37
12	Poland	10	21
13	Spain	10	60

Table 5 — Most Prolific National organizations

Organizations	DC	IC	TCP	TP
Dr DY Patil Vidyapeeth Pune	0	27	27	28
All India Institute of Medical Sciences New Delhi	10	6	16	23
Post Graduate Institute Of Medical Education Research Chandigarh	6	4	10	21
IITs	8	3	11	15
Tata Memorial Hospital	4	3	7	12

DC= Domestic Collaboration; IC= International Collaboration; TCP= Total publication in collaboration; TP=Total publication

Table 6 — Most Prolific International organizations

Foreign universities	No of Publications
Hainan Medical University, China	26
Sanitation 1 Medical Academic Center, Bangkok, Thailand	10
University Of London, UK	9
Chinese University of Hong Kong, Hong Kong	8
National University Of Singapore, Singapore	8

per publication. There are 27 countries having only one publication in collaboration with India.

Most prolific institutes

There are approximately 869 national and international organizations which have contributed in the publication of these research outputs in COVID-19. Among the national organizations Dr. DY Patil Vidyapeeth, Pune is the leading organization with total of 28 publications out of which 27 are in collaboration with international organizations and one publication with no collaboration. This is followed by All India Institute of Medical Sciences New Delhi with total of 23 publications out of which 16 are in collaboration, 6 of the 16 publications are in international collaboration and 10 are in domestic collaboration. Post Graduate Institute Of Medical Education Research Chandigarh have published 21 publications in which 10 are in collaboration , six of these 10 publications are in domestic collaboration and 4 are in international collaboration. IITs have contributed 15 publications with three publications in international and eight papers in domestic collaboration. Tata Memorial Hospital has contributed 12 publications with 4 in domestic and 3 in international collaboration (Tables 5 & 6). Among the foreign organizations Hainan Medical University, China with 26 publications is the most preferred organizations followed by Sanitat 1 Medical Academic Center, Thailand with 10 publications, University Of London, the UK with 9 publications, Chinese University of Hong Kong, Hong Kong and National University of Singapore, Singapore with 8 publications each.

Authors

There are a total of 1311 numbers of national and international authors contributing these 290 papers on COVID-19 research. The co-authorship network of authors reveals that there are 55 items in 2 clusters; Cluster 1 consists of 28 items while cluster 2 has 27 items (Fig. 1). Among Indian authors, Viroj Wiwanitkit is the most productive authors with 30 publication having 46 citations, followed by Kuldeep Dhama with 6 publications having 81 citations, Rakesh Lodha with 6 publications and 3 citations, Debanjan Banerjee with 5 publications and one citation, and Kaushik Bhattacharya with 4 publications with the same number of citations. Among the foreign authors, Beuy Joo is the leading author with 14 publications and 35 citations followed by Mohamaad Goldust with 6 publications and 6 citations, Sora Yasri with 6 publications and 1 citation, Mohammad Jafferany with 5 publications and 6 citations.

Highly cited articles

Table 7 represents the top 5 highly cited articles which shows highest citations received publication authored by Rodriguez-Morales *et al*. entitled Clinical, laboratory and imaging features of COVID-19: A systematic review and meta-analysis published in Travel Medicine and Infectious Disease, with 51 citations followed by Tanu Singhal entitled A Review of Coronavirus Disease-2019 (COVID-19) published in Indian Journal of Pediatrics with 37 citations Leng, Zikuan *et al*. entitled Transplantation of ACE2(-) Mesenchymal Stem Cells Improves the Outcome of Patients with COVID-19 Pneumonia published in Aging and Disease with 28 citations, Joob, Beuy & Wiwanitkit, Viroj entitled COVID-19 can present with a rash and be mistaken for dengue published in Journal of the American Academy of Dermatology, with 22 citations and Phua, Jason *et al.* entitled Intensive care management of coronavirus disease 2019 (COVID-19): challenges and recommendations published in Lancet Respiratory Medicine with 21 citations.

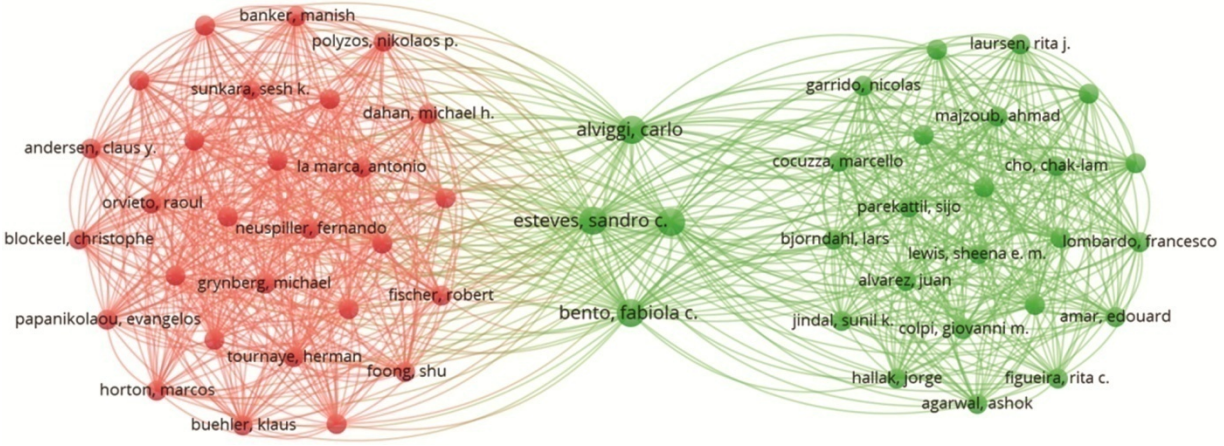

Fig. 1 — Co-authorship network

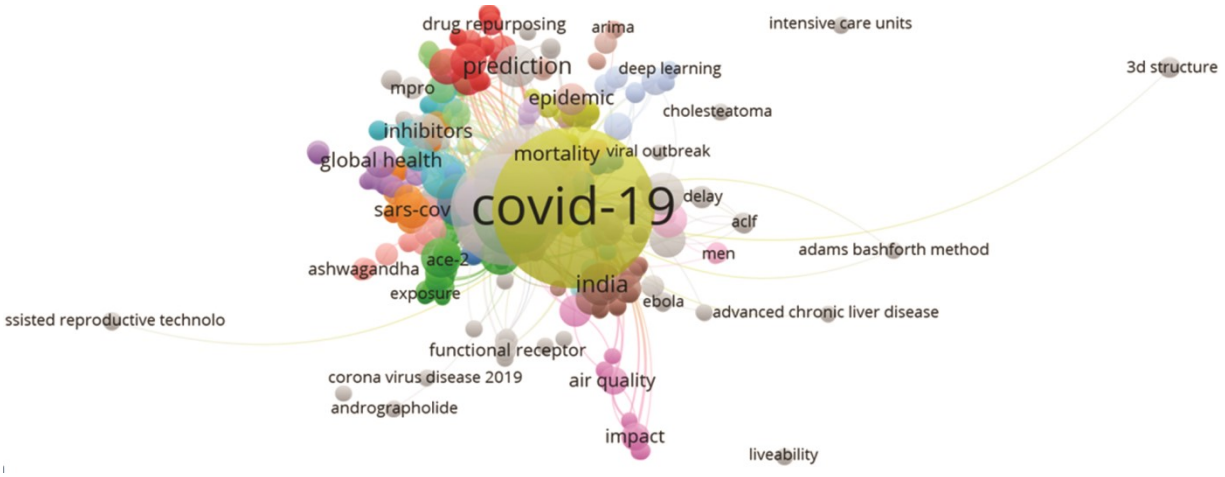

Fig. 2 — Keyword network

Table 7 — Highly cited articles

Author	Title	Reference	Citation
Rodriguez-Morales *et al.*	Clinical, laboratory and imaging features of COVID-19: A systematic review and meta-analysis	Travel Medicine and Infectious Disease, 2020 34	51
Singhal, Tanu	A Review of Coronavirus Disease-2019 (COVID-19)	Indian Journal of Pediatrics, 2020, 87 (4), 281-286	37
Leng , Zikuan *et al.*	Transplantation of ACE2(-) Mesenchymal Stem Cells Improves the Outcome of Patients with COVID-19 Pneumonia	Aging and Disease, 2020, 11 (2), 216-228	28
Joob, Beuy & Wiwanitkit, Viroj	COVID-19 can present with a rash and be mistaken for dengue	Journal of the American academy of Dermatology, 2020, 82 (5), 177	22
Phua, Jason *et al.*	Intensive care management of coronavirus disease 2019 (COVID-19): challenges and recommendations	Lancet Respiratory Medicine, 2020, 8 (5), 506-517	21

Keywords

The analysis of keyword through Vosviewer software reveals that there are 707 keywords available in these publications. There are 583 keywords that have appeared only one time, 124 keywords have a frequency of two. There are six keywords with more than ten frequencies among which COVID-19 is the most frequent keyword with 98 frequencies followed by SARS-COV-2 with 47 frequencies, coronavirus with 46 occurrences, sars 21 have been used 21times, pandemic appeared with the frequency of 15 and pneumonia have shown 11 occurrences (Fig. 2).

Conclusion

This study revealed that international collaboration results in higher impact and citation in comparison to non-international collaboration publications. The collaboration pattern also reveals that publications co-authored in international collaboration find its place in a relative higher impact journal in comparison to domestic collaboration indicating direct correlation with international collaboration and impact factor. We also found that only 13.10% of total publication output are without any collaboration. However, this study is based on a small set of data, the detailed analysis with a large sample is to be explored to find out more insights.

Conflict of Interest

All authors declare no conflict of interest.

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